DOCUMENT RESUME

ED 460 865 SE 065 687

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TITLE The Effects of Practice Reading of ACT Science Passages.
PUB DATE 2001-00-00
NOTE 22p.
PUB TYPE Reports - Research (143)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Achievement; Grade 11; High Schools; *Reading; Science Instruction; *Science Tests; Secondary Education; *Test Coaching
IDENTIFIERS *ACT Assessment; Scholastic Aptitude Test

ABSTRACT

This study investigated the effects of two practice reading methods (an ACT [American College Test]-prep program) on the performance of 11th grade students (N=43) on an ACT science portion mockup sub-test. A pre-test, treatment, post-test with control group design was used in the study. The treatments included that students read the ACT science passages and answered the accompanying questions with or without small group discussion and reasoning for 20 or 30 minutes weekly. This experiment lasted for 10 weeks. Analyses of data via the Dependent t test and the ANCOVA (Analysis of Covariance) test indicated that both the treatment and control classes made significant improvement by the end of the study. No difference was found between the classes in terms of the improvement, which suggests that both treatment methods used in the study were effective in preparing high school students for taking the ACT science portion sub-test. (Contains 26 references and 2 tables.) (Author/MM)

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ED 460 865

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The Effects of Practice Reading of ACT Science Passages

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Abstract

This study investigated the effects of two practice reading methods (an ACT-prep program) on the performance of 11th grade students (N= 43) on an ACT science portion mockup sub-test. A pretest, treatment, posttest with control group design was used in the study. The treatments included that students read the ACT science passages and answered the accompanying questions with or without small group discussion and reasoning for 20 or 30 minutes weekly. This experiment lasted for 10 weeks. Analyses of data via the Dependent t test and the ANCOVA test indicated that both the treatment and control classes made significant improvement by the end of the study. No difference was found between the classes in terms of the improvement, which suggests that both treatment methods used in the study were effective in preparing high school students for taking the ACT science portion sub-test.

The Effects of Practice Reading of ACT Science Passages

Today most colleges use standardized tests such as ACT (American College Test) or SAT (Scholastic Aptitude Test) in reaching admission decisions (Chenoweth,1997; Smyth,1995). Increasingly, high school counselors are asked about which test to take and which test to submit to colleges. The fact that most students take the college entrance exams and most high schools want students to perform well on those tests indicates a need for high schools to help students perform well on those tests. Understandably, many high schools now offer some kind of test-prep programs to their students as a way to help them improve performance on these tests. In the same spirit, some educators suggest that schools offer the best test-prep program and offer it early (Carris,1995). It seems that helping students perform well on ACT test is beneficial to the college-bound students. An effective ACT-prep program would facilitate the realization of this goal.

In the past two decades, research literature on the AC T test related issues has been greatly expanded. A wide range of issues related to ACT have been studied. The following issues selected from the literature are more related to the research focus of this study. The first area of ACT-related research is on whether and to what extent ACT test scores are related to student academic achievement and other factors. A number of such studies are available in the literature. In a study on the association of ACT scores with various factors, Ching (2000) found that almost 56 percent of the ACT efficiency test scores was explained by student eligibility for free lunch, assessed valuation, gifted students, teacher emergency certification, and district enrollment. With respect to the correlation between ACT scores and the success of criminal justice students in college, findings from Wilson's study (1995) indicated a high rate of success for students with the

highest ACT scores. And overall, there was a lack of consistent results in the analysis of the relationship between ACT scores and college GPA for this group of college students. In an investigation of possible correlates of student athlete's success in meeting the minimum National Collegiate Athletic Association requirements for participation in Division I athletic programs, Gardner (1996) reported that there was no significant relationship between the 20 personal characteristics taken from Giddan's ICD and ACT test scores for both successful and unsuccessful student-athletes as a total population.

Additionally, Harper (1993) examined the relationship between ACT scores and race, sex, socioeconomic status, GPA, the California Achievement Test (CAT) total reading score in grade eight, and CAT total math score. He found a significant relationship between total ACT scores and sex, GPA, CAT total reading and total language scores in grade eight, composite ACT and composite CAT scores, and an independent relationship between ACT total reading, total language, total math and CAT total reading, total language, total math test scores in grade eight while controlling for race, sex, GPA, and socioeconomic status. With a similar focus, Pappas (1990) studied the relationship between ACT test scores and selected student, school and family variables. According to his observations, high school GPA, high school class rank, and ethnicity had the greatest relationship to ACT test scores. Family income level, graduating class size and a school district's cost per pupil had very little relationship to ACT test scores. Likewise, Morgan (1992), Noble, Davenport, Schiel and Pommerich (1999) reported similar findings. The same type of studies continue as follows.

With a similar research focus, Spellhaug (1990) investigated the relationship between selected school climate variables and student achievement as measured by ACT. This study

utilized a national sample of 668,402 students. His findings showed that students' self-perceived satisfaction with the selected 12 factors of high school experience and achievement accounted for about 35 percent of the variance in English Usage scores, 44 percent of the variance in Math Usage scores, 41 percent in Social Studies Reading scores, 40 percent in Natural Science Reading scores, and 44 percent in overall composite. With regard to the relationship between school district size and other characteristics to student achievement as measured by ACT composite and sub-test scores, Richardson (1990) found that when school size was held constant, the ACT composite mean score difference between the smallest and largest school categories was 1.3 standard score points; in each ACT sub-test, larger schools consistently outperformed smaller ones. The mean differences increased to 7.4 standard score points, favored schools with lower percentages of low income and minority students, and higher percentages of students completing the college core.

A subarea of the ACT correlation research is on how ACT has been used as a predictor of college performance. Focusing on finding a collection of predictor variables that can be used to determine the proper placement of college students into their entry level math course, Daunis (1988) reported low correlations between predictors and measures of student success. Prediction accounted for 20 to 50 percent of the variance in grade. Similarly, in an effort to determine the best predictor, Gee (1988) examined the correlations between high school GPA, ACT test scores, ASSET test scores and first semester college GPA with a student's sex, age, and college major as the independent variables for community college students. Results showed that the strongest correlations were between high school GPA and ACT scores for all the independent variables. For students who majored in vocational education and students who were 20 years of age and older,

non-significant correlations were found between ACT test scores and ASSET test scores, between high school GPA and college GPA.

In another subarea of ACT correlation research, a number of studies focused on comparing the performance differences of some cultural groups on ACT. After assessing the utility of using both the ACT composite score and high school GPA as predictors of students' success in college, Myers and Pyles (1992) observed that the use of both the ACT score and high school grades would overcome the objections to using only the ACT score, which itself was not a good predictor of college success for many minority students. Similarly, Wood (1990) assessed ethnic group performance of college students, and found significant differences between four ethnic groups, although there were no significant differences on GPA. The relationship between the ACT total score and GPA was strongly positive for the African American and Caucasian groups, but was negative for Asian and other groups. Therefore, Wood observed that the ACT Objective Test might possibly be a culturally biased instrument. In addition, Whitworth (1987) investigated the differences in ACT test scores of Afro-American and Caucasian students who were similarly situated with respect to seven variables. He found that difference in ACT test scores resulted more from how one was situated than from one's racial/ethnic group. The six independent variables accounted for 38% of the variation in the ACT composite score for Afro-American students, 37% of the variation for Caucasian students. GPA accounted for the greatest variation in all test scores for both Afro-Americans and Caucasians. Family income was positively associated with variation in test scores for both racial groups, but accounted for more variation in the test scores of Afro-Americans than it did for Caucasians. Years of study of English accounted for the least variation in the composite scores for both groups. The same type

of studies continue.

With a similar focus, Walton (1995) examined the differences between ACT subject area and composite test scores of Afro-American and Caucasian students who attended the same high school, who had the same high school GPA, same plan of study of math, same family income level, same gender, and who were in the same grade in school when tested. Her results indicated that when Afro-American and Caucasian students were similarly situated, their test score differences were reduced significantly. The analysis found score difference reductions of 71% in math, 55% in reading, 59% in both English and Science Reasoning, and 60% in the groups' composite score as compared to the score difference of the national population. The variable with the greatest impact on the ACT score differences was the students' high school GPA. All the variables together accounted for 37% of the variation in scores for Caucasian students and 38% for Afro-American students in the study sample, while high school GPA accounted for 32% of the variation in the composite score of Caucasian students and 31% for Afro-American students. In a similar study that compared ACT test scores of Hispanic and Caucasian students who were similarly situated with respect to 13 variables, Peterson (1989) reported that differences in academic achievement, as measured by the ACT test, resulted more from how one was situated than from one's racial/ethnic group affiliation. Based on the above findings in the literature, it seems to be logical to say that in college admission decision making for the minority students, ACT test scores should be used with caution as a predictor of performance in college.

A body of the literature contains knowledge learned from studies on the effects of ACT preparation activities on students' ACT test scores. Both negative and positive results have been reported in these studies. In an investigation that involved two studies and a large number of

participants (Scholes & Lain, 1997), results of the first study (N = 10% of 69, 251 students) showed that almost half of the sampled students had engaged in some of form of test preparation, and the type of test preparation studied had little impact on student performance, with only practice tests showing a positive but small impact. In the second study, the sample consisted of ACT repeaters (N = 126,253). The results indicated that over half of the repeat test takers engaged in some type of test preparation before the second ACT. However, the results also suggested that test preparation activities had only a minimal impact on increasing the second test scores beyond gains from simply retaking the test. Negative findings were also reported in the following studies.

Lauderdale (1989) examined the effects of using computers and the Krell software as a means of preparation for ACT. The main finding of the study was that there was no assurance that time spent with the Krell software would improve a student's ACT scores. With regard to the efficacy of test performance intervention and self-monitoring on ACT math scores, and test anxiety of low scoring minority college students with an interest in teacher education, Dulan (1990) found no significant difference between the experimental and control groups on the ACT math scores, anxiety and academic performance. With a similar effort, VanScoy (1997) studied the effects of test preparation programs on ACT math scores. His conclusion was that the week-long lunch hour preparation was not effective because there were too many students and not enough time. According to VanScoy, the best way a student could improve his/her math score was to enroll in more preparatory math classes. Another way to do so was to have his/her teacher acquire old ACT tests and use them for problems of the day. It seems that the negative findings from those ACT-prep programs resulted largely from problems in program design and

implementation.

Apart from the studies with negative findings for those ACT-prep programs, a number of studies also reported positive results. To identify instructional methods that could potentially improve student scores on ACT, Weaver (1988) conducted a study that provided computer training sessions in preparing students for ACT test with a variety of training programs and teacher interventions. The researcher found that the specialized computer coaching, teacher coaching and cooperative learning for the experimental group resulted in a significant difference in increased scores. Furthermore, Mcmann (1994) examined the effects of using practice items and test preparation activities on ACT math scores of students in second-year algebra class. Her findings were that students in the experimental group outscored their counterparts in the control group. Gender did not show significant difference in the students' ability to learn from coaching practice. The prior number of years of math taken showed no significant difference. Students in the honor section showed more improvement than the average students did.

The above brief review of the most related literature seems to indicate that ACT test scores are related to students' achievement in high schools and colleges, and are also related to some other factors. Furthermore, ACT test scores are not a reliable predictor of college achievement for minority students. In addition, it appears that research literature on ACT-prep programs is currently scarce, research-based evidence on the efficacy of ACT science area sub-test preparation is not available in the literature, and the issue remains to be studied. The purpose of the study was to investigate the effects of two practice reading methods on 11th graders' performance on the ACT science portion mockup sub-test.

Method

Participants

The participants in this study were11th grade chemistry students from three classes (N = 43). Out of the 43 students, 37 were Caucasian, 1 African American, 5 Asian. Their ages ranged from 16 to 17 years. The classes were in place as Honors Chemistry Classes (composed of students with average and above average achievement) prior to the start of the study. In Class 1, there were 15 students (13 females, 2 males); there were 12 students in Class 2 (8 females, 4 males); in Class 3, there were 16 students (8 females, 8 males). Prior to the start of the study, the average GPA in chemistry (the highest scale being at 5.3 as corresponding to a grade of A+) for Class 1 was 3.0; that for Class 2 was 3.3, and the average GPA for Class 3 was 4.0. The academic performance of the three classes in the chemistry course was considered to be not much different from each other by their science teachers. The students of the high school mostly were from middle and upper-middle income families. The school was located in a mid-west suburban area.

The participating teacher, Caucasian, female, had two years of teaching experience, and was certified to teach chemistry. She had worked in a medical clinical laboratory as a professional for 5 years before she started teaching.

Procedure & Design

The study utilized a pretest, treatment, posttest with control group design (2 treatment classes, 1 control class). By a random procedure, Class 3 was selected as the control class, Class 1 and 2 became the treatment classes. The researchers prepared three paper strips marked with number 1, 2 or 3 respectively, and they were wrapped up and placed on a desk; the strip with the number 3 was the one that was selected as the control group.

For the pretest, all the participating students were given by the participating teacher a mockup ACT science portion sub-test, which was a timed 35-minute test. The following week, the students began the ACT practice reading sessions. The time allocated for the control group's weekly ACT practice reading was 20 minutes, that for the treatment group was 30 minutes. On Friday of each week, the students entered the classroom and picked up a reading passage with a science topic accompanied by 10 questions, which were selected from the science portion of ACT book (Harcourt Brace & Company, 1998). Then the students of the control group would read the passage and answer the 10 questions within a 15-minute period. Thereafter, the teacher would orally provide correct answers to the students of the control group. (The treatment that the control group received was Treatment 1, or the standard treatment of this study.) This whole process for the control class lasted for approximately 20 minutes.

The two treatment classes would engage in the same reading-answering activity as the control class did for 15 minutes. However, they received additional treatment that consisted of small group discussions and reasoning. (The combined treatments were Treatment 2.) Then the teacher would assign 2 to 3 questions to the small groups (3 to 4 students in a group) in a treatment class for review and discussion. The students would underline on their given passage support for the correct answers to their assigned questions. Thereafter, students of the small groups would orally explain to the rest of the class why the answers they selected were the best ones (a reasoning process, per se). This was the first version of the treatment they received. The second version of the treatment included small group discussions and also that the students in each group would explain to the rest of the class why the other three options were not the best answers to a question. The two treatment versions alternated weekly. The teacher would also

provide correct answers to the treatment classes at the end of the activity. Results for the weekly reading tests were recorded and examined by the participating teacher for students' progress. At the end of 10th week into the ACT science reading practice sessions, all three classes received a posttest (the same as the pretest).

Instrument

The testing material used in the study was selected from the ACT book (Harcourt Brace & Company, 1998), specifically from its science portion. Two types of test materials were used in the study: The pretest (same as posttest) contained four ACT science reading passages and 40 multiple-choice questions; a weekly ACT reading package included a reading passage accompanied by 10 multiple-choice questions. The science reading passages represented all areas of science to reciprocate the ACT format. The main areas of the sample readings include earth science, chemistry, biology, botany, astronomy and genetics. On either the pretest (posttest) or the weekly tests, a correct answer was scored 1 point, with a total of 40 points for the pretest/posttest, 10 points for a weekly test. The pretest and posttest were scored by the teacher, and the weekly test was scored by individual students, based on the correct answers provided orally by the teacher.

A Dependent t Test was conducted to compare the pre- and posttest results of each class to see whether a class made real progress in their performance on the ACT science portion mockup sub-test. An Analysis of Covariance (ANCOVA) test was conducted to compare the pre- and posttest results of the three classes to see whether there was a difference between the treatment and control groups in their performance on the ACT science portion mockup sub-test.

Results

Results from the Dependent t Test indicated that every class made significant improvement in their performance on the ACT science portion mockup sub-test at the end of 10 weeks. See Table 1. Results from the ANCOVA test showed that no significant difference was found between the treatment and control classes in their performance on the ACT science portion mockup sub-test at the end of the 10 weeks. See Table 2.

Discussion

This study investigated the effects of a practice reading program for helping high school students improve performance on the ACT science portion sub-test. By nature, this practice reading program is also a review process. In this process, the participating students read the science passages and answered the given questions, with or without small groups discussions and reasoning, with the teacher providing correct answers as feedback. This type of intervention occurred once a week, which lasted for 20 minutes for the control class (Treatment 1) and 30 minutes for the treatment classes (Treatment 2). Even though the intervention/training occurred once a week for only 20 to 30 minutes, the results were encouraging. This type of ACT-prep activity did help the participating students improve performance on the ACT science portion mockup sub-test. It seems practical for a science teacher to allocate 20 to 30 minutes each week for this kind of ACT-prep activity. The authors believe that it is a doable program for any science teacher.

In this study, two main treatments were implemented. As indicated by the results in Table 1, both treatments were effective based on the Dependent t analysis. Even though the method (treatment) used by the control group involved only "reading, answering and teacher feedback,"

the activity seemed to have helped the students improve as much as the method used by the treatment group did, which had an analytical and a cooperative learning component. Treatment 2 was effective as indicated by Table 1, but only as effective as Treatment 1, not a better method, per se. One would assume that a reading activity with an analytical and cooperative learning element (Treatment 2) would be more effective in terms of student learning outcomes. However, the data did not show such evidence, as indicated by Table 2. The two treatments (methods) were effective in that both treatment and control groups significantly improved their performance on the ACT science portion mockup test. However, further studies are vitally necessary before a definitive answer can be made about the two treatment approaches.

This study used a three-group design due to the fact that four groups were not available. Although it is not as good as a four-group design, it may be considered a better design than a two-group design. In the three-group design, two groups (classes) received the same treatment or one treatment is repeated. Thus the chances for making an error judgement about the treatment effects should be greatly reduced. Here the chances for making a Type I error are reduced by design. However, the other side of picture is that one can not say the same thing about the one control group (class) used in this type of design. Thus the judgement made about the effects for the control group (or the standard treatment group) still carries the same amount of chance error as that in a two-group design. Even so, a three-group design, in the authors' view, is better than a two-group design.

Due to the administrative limitations, the sample used in the study was relatively small. Interpretation of the results should be made with caution. Further studies are necessary in order to further validate the experimental results.

Conclusion

The findings of this study indicated that students in Treatment 1 condition (the reading-answering-feedback method) made significant progress in their performance on the ACT science portion mockup sub-test. So did students in Treatment 2 condition (the reading-answering/discussion-reasoning-feedback method). However, as the results of the two treatments were compared with each other, no significant difference was found. Based on this evidence, it is tentatively concluded that both the "reading-answering-feedback" method and the "reading-answering/discussion-reasoning-feedback" method can be used to effectively help11th graders prepare for taking the ACT science sub-test.

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Table 1

Results from Dependent t Test – Within Class Effects

Class	Pretest Mean	Posttest Mean	df	t	p
1	19.73	27.33	14	-5.54	.000
2	24.25	27.75	11	-3.57	.004
3	27.38	30.5	15	-4.42	.000

Table 2

Results from ANCOVA Test – Between Class Effects

Source	SS	df	MS	F	p
Pretest*	249.087	1	249.087	21.855	.000
Class	23.306	2	11.653	1.022	.369
Error	444.497	39	11.397		

* Pretest = Correlations between the pre- and postest.